REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Applicants have endeavored to amend the application in a sincere attempt to place it in condition for allowance, and reconsideration is respectfully requested in view of the amendments above and the remarks below.

Claim 11 has been canceled.

Claim 10 has been amended. Support for the amendments can be found on page 7, lines 9-10 and page 10, line 8 through page 11, line 10 of the instant application.

Claims 21-30 have been added. Support for the new claims can be found on page 6, line 5 through page 11, line 10 of the instant application

No new matter has been added.

35 USC 103 Claim Rejections

The Examiner has rejected claims 10-20 as being unpatentable over U.S. Patent No. 5,478,780 to Koerner et al. in view of U.S. Patent No. 5,043,299 to Change et al.

As recited in amended claims 10 and 12-20, the present invention provides an apparatus for selectively forming a metal silicide over a semiconductor substrate, within a continuous vacuum, and subsequently removing portions of the metal which did not react during such silicidation process to form silicide. (See the specification at page 9, lines 7-10.) The apparatus includes a semiconductor

substrate having silicon and insulator portions on a surface thereof, with an oxide layer thereover. The substrate is on a pedestal in a chamber that has at least one pump and one line to evacuate and maintain the chamber at a continuous vacuum. A chemical agent is provided within chamber, via an input line, to remove the oxide from the surface of the substrate while in the continuous vacuum. An input line removes the cleaning agent and the oxide. A reactor is within the chamber to deposit a metal onto the silicon and insulator portions on the substrate surface while in also in the continuous vacuum. A heating element then heats the substrate to selectively form a silicide over the silicon portion on the substrate by reaction with the metal deposited thereon, while the metal remains unreacted over the insulator portion. An etchant then removes unreacted metal from the substrate surface, thereby selectively leaving silicide only on portions of the semiconductor substrate surface.

Further, newly added independent claim 21, with claims 22-29 dependent thereon, and independent claim 30 are also directed, respectively, to a system and an apparatus in combination with a semiconductor substrate for selectively forming a silicide on a substrate surface. The system and apparatus include a semiconductor substrate having silicon and insulator portions on a surface thereof, with an oxide layer thereover, in a chamber that has a pump to evacuate and maintain the chamber at a continuous vacuum. A chemical agent removes the oxide from the surface in the chamber and a reactor deposits a metal onto the silicon and insulator portions in the chamber. A heating element heats the substrate

to selectively form a silicide over the silicon portion on the substrate by reaction with the metal deposited thereon, while the metal remains unreacted over the insulator portion. An etchant removes any unreacted metal from the substrate surface, thereby selectively leaving silicide only on portions of the semiconductor substrate surface.

The Examiner states that Koerner et al. disclose an apparatus for forming a silicide on a surface of a silicon (col. 4, row 59) semiconductor substrate, comprising: a plurality of interior chambers (Fig. 1, 1-6; abstract) in which multiple method stages (including removing an oxide using a cleaning agent, depositing a metal layer and heating) can be carried out at high vacuum without interruption. The Examiner continues by stating that Koerner et al. fails to disclose specific structural details as recited by applicants, as well as fails to disclose the use of nitrogen triflouride as a cleaning gas to remove silicon oxides. However, the Examiner states that Chang et al. discloses apparatus known to be needed to clean a wafer without exposing such cleaned wafer to contamination prior to deposition, as well as the use of nitrogen triflouride as a cleaning gas. The Examiner contends that applicants' invention would have been obvious to one of ordinary skill in the art at the time the invention was made in view of equipping the chamber as disclosed by Koerner et al. with apparatus known to be needed to process a wafer without exposing a cleaned wafer to contamination prior to deposition as disclosed by Chang et al.

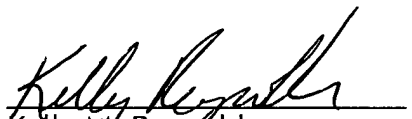
Applicants disagree and respectfully submit that the instant invention would not be obvious over Koerner et al. in view of Chang et al. It is respectfully submitted that Koerner et al. does not disclose, suggest or teach removing oxide over a surface of the substrate to selectively form a silicide only over portions of the substrate surface. As disclosed in column 8, lines 37-66 and in Fig. 3, Koerner et al. discloses removing oxides particularly in the interconnect regions and the gate contacts to form silicides on such interconnects and contacts. Koerner et al. refers to a "uniform silicidation of the layers", thereby not disclosing selectively forming silicides over only desired silicon portions of the semiconductor substrate's surface, as recited in applicants' claims. Koerner et al. suggests only complete silicide formation over the entire substrate surface, as depicted in Fig. 3. It does not disclose or suggest forming a silicide only over desired portions of the substrate surface. Thus, applicants submit that Koerner et al. does not disclose, suggest or teach applicants' invention as claimed in the present application.

It is also submitted that the Chang et al. reference does not remedy the deficiencies of the Koerner et al. patent as Chang et al. is merely directed to a process for forming a tungsten layer on an unmasked, cleaned wafer surface. (Abstract.) Accordingly, neither Koerner et al. nor Chang et al., alone or in combination, disclose an apparatus or a system for selectively forming a metal silicide over portions of a semiconductor substrate, within a continuous vacuum, by removing portions of metal that did not react during a silicidation process as recited

in pending claims 10 and 12-30. It is respectfully submitted that neither Koerner et al. nor Chang et al., alone or in combination, render obvious the instant invention.

It is respectfully submitted that the application has now been brought into a condition where allowance of the case is proper. Reconsideration and issuance of a Notice of Allowance are respectfully solicited. Should the Examiner not find the claims to be allowable, Applicants' attorney respectfully requests that the Examiner call the undersigned to clarify any issue and/or to place the case in condition for allowance.

Respectfully submitted,



Kelly M. Reynolds
Reg. No. 47,898

DeLIO & PETERSON, LLC
121 Whitney Avenue
New Haven, CT 06510-1241
(203) 787-0595

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date indicated below as first class mail in an envelope addressed to the Assistant Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Name: Carol M. Thomas Date: October 17, 2002 Signature: 

IBMB110231000AMDa

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claim 11 has been canceled, claims 21-30 have been added and claim 10 has been amended as shown below.

10. (Twice Amended) An apparatus for selectively forming a silicide ~~on a surface of a semiconductor substrate,~~ comprising:

a semiconductor substrate having a surface, a portion of said surface having silicon thereon and a portion of said surface having an insulator thereon, said surface further having an oxide thereover;

a chamber;

at least one workpiece holder within said chamber adapted to hold said substrate;

at least one pump adapted to evacuate said chamber to maintain a continuous vacuum in said chamber;

at least one line operatively connected between said at least one pump and said chamber for evacuating said chamber;

at least one input line adapted to provide a chemical agent into said chamber while in said continuous vacuum, said chemical agent adapted to remove ~~an~~ said oxide from said surface of said substrate;

at least one output line adapted to remove said cleaning agent and said removed oxide from said chamber;

~~a heating element in said chamber, said heating element adapted to heat said substrate to an elevated temperature; and~~

a reactor in said chamber, said reactor adapted to deposit a metal onto said silicon and insulator portions on said substrate surface while in said continuous vacuum;

a heating element, said heating element adapted to heat said substrate to an elevated temperature to form a silicide on said substrate surface over the silicon portion by reaction with the metal deposited thereon, while the metal remains unreacted over the insulator portion; and

an etchant to remove unreacted metal from the substrate surface while leaving said silicide over portions of said semiconductor substrate

~~wherein said apparatus is adapted to form a continuous vacuum therein, said apparatus further adapted to remove said oxide from said surface of said substrate and deposit said metal on said surface of said substrate while maintaining said continuous vacuum~~.